DISTRICT ELECTRIC TRAINS
27 – R STOCK DETAILS
by Piers Connor

MORE Rs

Before looking at some of the details of R Stock design, I should mention the arrival of the final batch of R Stock, especially since they had a few detailed peculiarities of their own. The third, final and rather small batch of R Stock was ordered in 1959 and, as we might guess, it was known as R59 Stock. It consisted of 13 new Non Driving Motor cars (NDMs) and 7 Q38 trailers that were converted to run with them. The R59 cars were, like the earlier R Stock batches, only ordered after much to-ing and fro-ing between various plans for new subsurface stock that had, as usual, been formulated and then rejected and then reformulated. It went on for several years and, regrettably to us today, it has a very familiar ring about it.

There were several threads. One of the earliest suggested buying ten more 8-car R Stock trains for use on the Metropolitan Line as part of the revived, pre-war, Amersham electrification scheme. This idea, drawn up in July 1956, was rehashed early in 1957 into a scheme where the new Metropolitan stock was to be built as 4-car units (DM-NDM-T-DM), and formed into 4-car or 8-car trains. At the same time, it was proposed that the District should get 62 more R Stock cars, which would be used to increase the Upminster service. They reckoned that more trains would be needed at the east end of the line after the electrification, by British Railways, of the former LT&S Fenchurch Street to Southend route.

By August 1957 another programme had been prepared. This included the purchase of 248 new cars for the Amersham electrification (which eventually became 31 x 8-car trains of A60 Stock), the lengthening of all 18 x 5-car Circle trains to 6 cars using Q38 trailers suitably converted for the purpose and the replacement of the 12 remaining cars of H Stock. Another part of the plan was use 2 x 3-car units of P Stock on the Chesham shuttle when that was electrified. They proposed converting 2 x 2-car P Stock units to 2 x 3-car units by adding a converted Q38 trailer in each. The shuttle was actually worked by P Stock for a short time but 2 x 2-car units were used. I can't imagine how this worked with the very restricted power supply provided up there but I suspect they would have restricted the operating speed and might even have isolated the regen. braking capability. Between 11 September 1960, which was the last day of steam operation on the branch and 31 July 1961, when the first new A Stock 4-car unit worked the service, both T Stock and P Stock worked the line. I have no evidence that F Stock ever got to Chesham.

As for the R Stock element in this programme, 2 x 6 cars were to be built to cover the Olympia service plus one extra 8-car train to cover the re-organisation of the Q Stock resulting from the Q38 trailer conversion programme. The numbers in this game worked out as follows:

- 20 x Q38 trailers to be converted to 18 O/P trailers to increase all Circle trains from 5 to 6 cars, and 2 to make 2 x 2-car P Stock units into 2 x 3-car units for the Chesham branch.
- 7 x Q38 trailers to be converted to R38 driving motor cars to run with 13 new NDMs of R59 Stock.
- 14 x Q23 motor cars to be converted to trailers to balance train formations after the loss of Q38 trailers to R Stock.

The programme was carried out more or less as planned except that the total number of Q38 trailers converted to O/P trailers was reduced to seventeen. This was because the Chesham P Stock scheme was dropped and the number of Circle trains was reduced by one because of their improved availability after conversion from Metadyne to PCM traction equipment, of

THE END OF THE H STOCK

By February 1954, there were only 12 H Stock cars left. These were all 1910-14 vehicles. Four of them were converted to stores vehicles in 1958 so didn't run in passenger service from that time. The remainder continued to appear in service from time to time. Two cars were scrapped in December 1956 but the remaining 6 survived until the late summer of 1961. Three of the stores vehicles survived until 1963 and

which more anon. In fact, the O/P trailers converted for the Circle from Q38 Stock became known as COP trailers to denote their use in CO/CP trains instead of O/P trains.

It is perhaps worth noting here that the planned new cars for the Metropolitan line – 62 x 4-car units – were eventually built as the A60 Stock in their present DM-T-T-DM form as opposed to the DM-NDM-T-DM unit mentioned above. As we shall see, the R Stock was to play a part in the development of the A Stock, as a number of its cars were involved in various experiments prior to the A Stock's introduction.

The R59 Stock was to continue the successful unpainted aluminium alloy design of the R49 type. New NDMs were to be built by Metro-Cammell and formed into trains with converted R38 driving motors. The conversions were to be done at Acton Works instead of by Gloucester, probably because there were only seven to be done and Acton could manage those amongst the usual overhaul work. The established R Stock numbering was continued for the new batch as shown in Table 1.

Table 1: R59 and R38/3 Stock Numbering

Position of car	Stock	Builder, or converted by	Car numbers	Total
A (west end) 1	R38/3	Acton	21148-50	3
2	R59	Metro-Cammell	23248-50	3
3	R59	Metro-Cammell	23348-50	3
4	R59	Metro-Cammell	23448-50	3
5	R59	Metro-Cammell	23583-86	4
D (east end) 6	R38/3	Acton	22683-86	4

The converted cars were given the designation R38/3 at this time. This was done to distinguish them from earlier batches, which were now called R38/1 if converted for R47 Stock or R38/2 if converted for R49 Stock. The total number of R Stock cars built was now complete: 132 cars of R38 Stock DMs and 246 new cars of which 6 were driving motors and the rest NDMs.

The first Q38 trailer for conversion to R38/3 was sent to Acton Works in October 1958, the last in March 1959. When they were turned out, they appeared in a silver paint job, designed to match the new NDMs. The new, unpainted aluminium alloy NDMs, which were virtually identical to the R49 ones, were delivered from Metro-Cammell's between June and September 1959. They were commissioned at Ealing Common and formed into units for service between August and October. All but the last train ran its first trip coupled to older R Stock. The last, 21148-23250-23350-23450+23586-22684, entered service on 26 October.

MOTORING & BRAKING

As I've mentioned before, the R Stock was given the same PCM type of traction control equipment used on the 1938 Tube Stock. The traditional resistance type PCM control, using camshaft-operated contactors, first appeared on a train of the 1935 Experimental Tube Stock. It was adopted for the 1938 Tube Stock and had, after a number of teething troubles, eventually proved very successful. The R Stock equipment was very similar but it incorporated some minor modifications based on experience with the 1938's equipment. The most significant change was the use of a combined volt-amp relay in place of the separate no-volt and low-current relays[1] used on the 1938 Stock.

One feature of the R Stock control equipment, which represented a great advance on all earlier designs, was the desk-type master controller. All previous controllers were vertically mounted and allowed the driver little room for his legs. The C707 desk type controller, first tried on 1938 Tube Stock car No.10230, had its contacts mounted horizontally on a shaft driven by the controller handle through gears. This allowed a knee-space below the controller and gave the driver a considerable improvement in his working environment. The knee-space was later used to install a small heater.

The braking system on the R Stock was also similar to the 1938 Tube Stock system. This was the Westinghouse-built self-lapping, mercury retarder-controlled, electro-pneumatic type D3 brake. It had e.p. service braking, with the standard Westinghouse quick-acting pneumatic brake as a back-up and for emergencies. Some of the equipment used on the first R Stock driving cars had actually been

[1] Perhaps a simple way of describing what these relays do is to say that, if the line voltage or current falls so low that the equipment won't respond properly, the relay "reboots" the PCM by forcing it to switch off and restart the acceleration sequence.

built in 1938. The R38 cars had, of course, some e.p. brake equipment under the car left from their Q38 days but many of the early R38/1 cabs were equipped with brake controllers ordered for the ex-Metropolitan Railway compartment-type T Stock. It had been planned to equip them with e.p. brakes in 1938-40 but the postponement of the Amersham electrification and the consequent cancellation of the T Stock e.p. brake scheme left the brake controllers spare.

Experience with e.p. brakes on the 1938 Tube Stock had shown up a number of problems and improvements were introduced on the R Stock. The original mercury retarder system was prone to electrical problems and these could happen without any indication to the driver that the e.p. brake was "going AWOL", so a modified retarder circuit was introduced on the R Stock to provide an audible warning (see box).

When the R38/3 cars were introduced in 1959, they arrived with further improvements in their e.p. braking system. Poppet valves had replaced the ground lap valves of earlier brake controllers, after trial controllers had been fitted to a number of cars, including R Stock No.21100, which ran with one from December 1954. The production version of this controller, the D5 type, was fitted to the R38/3 driving cars. There were also some more minor circuit changes but these were not allowed to interfere with the interchangeability of R59 units with the rest of the stock.

During the late 1950s there were a series of trials on a 1935 Tube Stock unit fitted with regenerative braking. Part of the equipment consisted of a special type of brake controller with a mercury retarder operated self-lapper. The device worked by tilting the retarder as the handle of the controller was moved. After the trials were over, the two brake controllers involved were fitted to a 1960 Tube Stock unit and later one of them appeared on R Stock car No. 22683. It ran with the device between 1961 and 1967. It was then returned to the 1960 Stock unit, and remained with it until the unit was withdrawn in 1977.

AUDIBLE WARNING

As I've written elsewhere, there was a general nervousness on the Underground in the late 1920s about the introduction of an electrically controlled brake and the possibility of its failing. To sooth the corporate unease, mitigation was provided in the form of an electrically controlled valve which monitored the brake's circuits. If anything went wrong with them, the valve opened and caused the Westinghouse automatic brake to apply. This was a fine idea, except that the constant movement of the brake handle and its contacts with the various circuits could occasionally cause a brief interruption of the electrical supply and this resulted in a short puff of air from the emergency brake control. The resulting short automatic application sometimes caused skidding and damaged wheels. Eventually, the monitoring valve was converted so that an audible warning replaced the brake application and let the driver decide for himself what to do. My experience of the system was that, apart from calling for a "fitter" to join the train to confirm the problem, we ignored audible warnings unless the brake actually failed to apply.

DOORS AND CABS

The door equipment on the R Stock was interesting. Although air-operated doors had been a familiar sight on the tube lines since the early 1920s, they had only been used on surface stock since 1936. Experience with their use, however, on both the tube and surface lines, had shown that the failure of one door to close could cause a delay to the train out of all proportion to the cause of the defect. This was usually only a cherry stone, cigarette packet or sluggish door engine, but it could take a long time to find when the only indication was the lack of the pilot light at the guard's position. To overcome the problem, therefore, a system of door fault indicator lights was devised. As we saw in Article 25 of this series, it was first tried on an 8-car train of Q Stock in conjunction with centre-guard control in 1949. Although the centre-guard idea was dropped, the door fault lights were adapted for the R Stock and all subsequent trains.

The lights were provided at cant rail level on each car, one light per car side. They were housed in diamond-shaped fittings which allowed the light to be seen from either end of the train. They were yellow in colour and worked the opposite way to the pilot light. The pilot light lit when all doors closed but the fault indicator light lit on any car when a door was open or rather, not fully closed. A relay on each car, called the signal relay, lifted when all the doors on the car were closed to provide the circuit to the pilot light, but "dropped" if a door failed to close and provided a connection to the fault indicator light.

An addition to the R Stock system was a door isolating switch on each car. This was worked off the door isolating cock so that, if the door operation on one car was isolated by closing the cock, the switch by-passed the signal circuit on the car. This allowed a train with defective doors on one car to remain in service without affecting the pilot light circuit. The idea was abandoned from May 1955 because passengers insisted on passing through the communicating doors to the empty defective car to get a seat and then, not realising until too late that the doors would not open, got carried past their destination or, more irritatingly, operated the emergency alarm which, in those days, stopped the train.

The R Stock was also the first to have mercury-contact door interlock switches and the first to have flat door tracks in place of the grooved tracks provided on earlier cars. Only the new cars had the flat tracks, which were supposed to overcome problems where cherry stones or matchsticks became trapped in grooved tracks. The R38 cars retained their grooved tracks. In later years, after the new stocks of the early 1960s had all had flat door tracks fitted, it was realised that they were not the whole answer to the problem and several re-designs of door tracks have taken place since.

The R Stock had rotary door controllers (Fig. 2). These were operated by a special key, the key being turned through 40° in one direction to give “normal open” or in the other direction to give “passenger open” in conjunction with a separate passenger open release button. Although fitted to both R47 and R49 batches, the passenger open system was not brought into operation until May 1956. It only lasted for three years, as it was withdrawn in March 1959 from all lines. The push buttons at each doorway lasted a few more years but they were eventually removed and the panelling made good on the outsides of the cars and covered with circular plates on the inside.

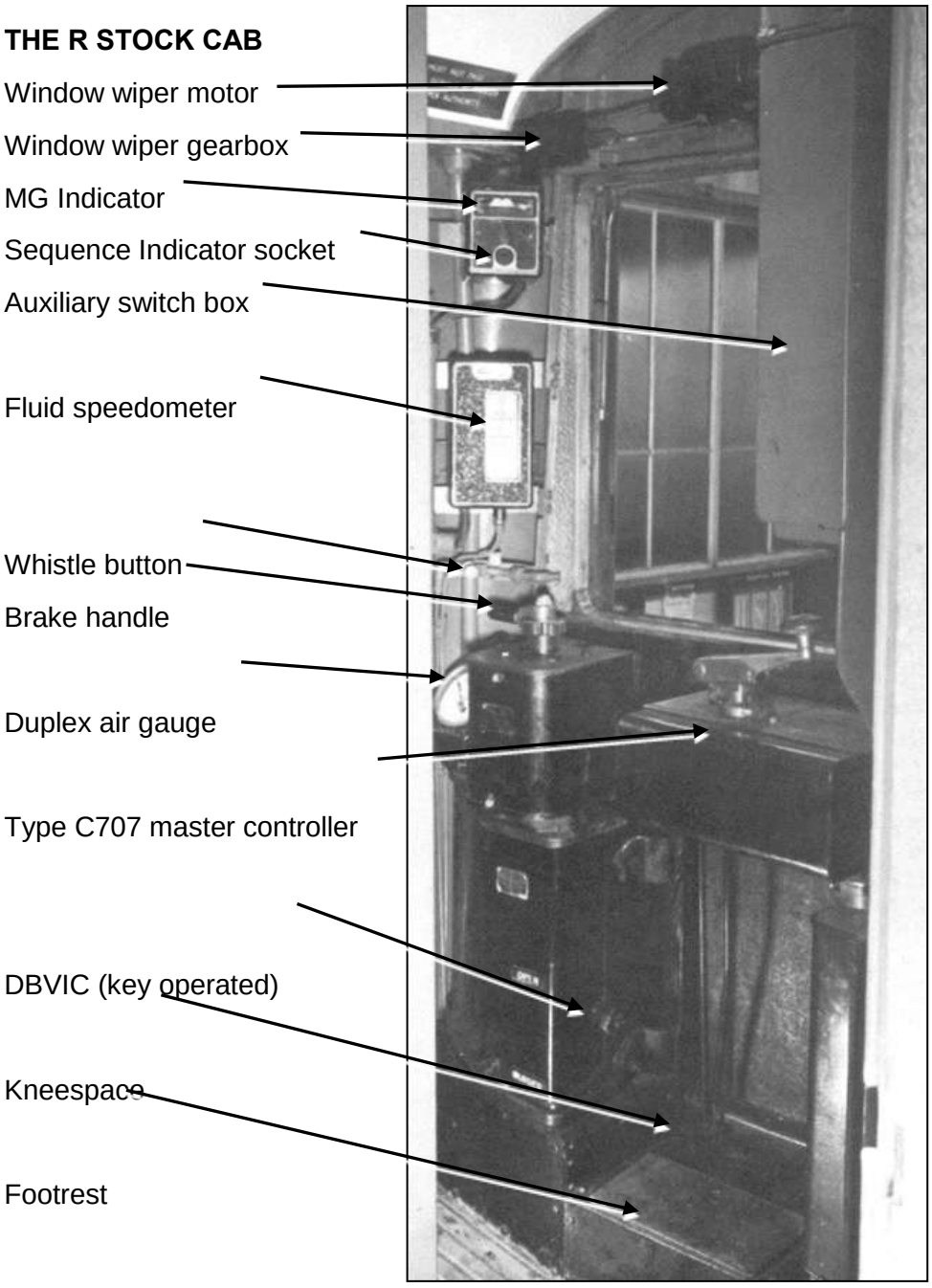

Fig. 1: R Stock cab.

After they’d done nearly twenty years in service, the door controllers were showing signs of their age and, since a large number of scrap door control panels were becoming available from the withdrawal of 1938 Tube Stock, it was decided to replace them.

During early 1973, the lower halves of the control panels were removed and replaced by the matching panels scavenged from withdrawn 1938 cars, suitably cut to fit. The upper parts of the R Stock panels were kept and they retained their original trigger switches, which were a unique feature of the stock.Trigger switches were also provided in the driver’s cabs, which themselves contained a number of new bits of kit. These included destination

blinds, individual marker lights, a fluid type speedometer, adjustable cab seat, an additional cab seat on the offside, a new master controller, an anti-glare shield, rubber door seals, a roof-mounted ventilator and better heating.

The R Stock was equipped with speedometers. These were unlike any seen before or since, being a fluid type. The idea was first tried on P Stock car No.14209. The cab was equipped with a vertical sight gauge which indicated the speed by the position of the fluid. It was driven by an impeller mounted on an axle. It was never a great success but it was usually reckoned to be within 10% of the correct speed. It was originally introduced in an attempt to overcome difficulties with the induction

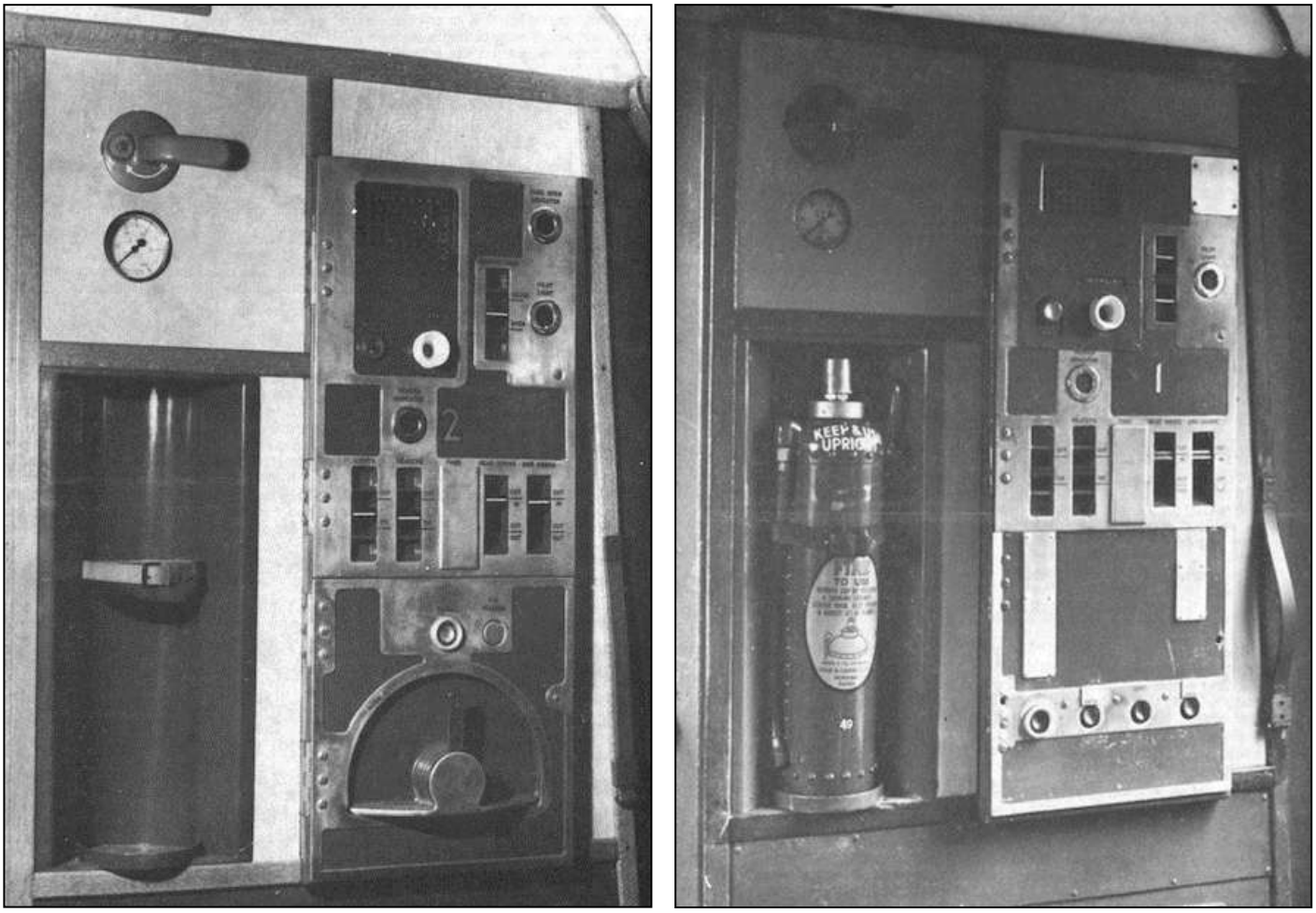

Fig. 2: R Stock door control panels, with the original rotary door controller panel on the left and the 1970s replacement push button panel on the right. The rotary controller was key operated and it was used to release the passenger open feature as well as open and close doors. The starting bell ("signal") button is immediately above the controller key in the "Off" position as seen here. On the right of the signal button is the passenger open release button, which had to be pressed at the same time as the "Passenger Open" position was selected with the controller. Above the signal button is a set of trigger switches. Reading from left to right: lights, heaters (with an indicator light above), fans (blanked off as the fans were never fitted), near doors cut out and end doors cut out. Above the heater indicator light is the "loudaphone" to the cab, with the guard's door control to the right and the pilot light to the right of that. At the very top right is the passenger open indicator. The replacement door controls (on the right) were robbed from scrapped 1938

type speedometers used on the 1938-built tube and surface stocks. As it did not come up to expectations it was only used on the 1947 and 1949 batches of R Stock.

The 1959 cars were fitted with modern generator driven speedometers after a successful trial of two on cars 21114 and 21119.

Another innovation on the R Stock was the driver's seat. Although it was of the usual District tip-up variety, it was also given an extra feature which allowed 3-position height adjustment. This feature was not provided on the new cars of the 1950s and 1960s but it did re-appear on certain cars of C69 Stock as an experiment to see if it could replace the notoriously unsuccessful C69 seat. The R Stock was also equipped with a folding occasional seat on the offside of the cab to give some relief to the

legs of an instructor who might have to supervise a new driver for as long as the 1 hour 25 minute journey from Upminster to Ealing Broadway[2].

The use of rubber door seals and an improved heater and ventilator layout on the R Stock was part of a campaign to give the drivers a more comfortable environment. The "too hot or too cold" syndrome which still affects many public service vehicles in Britain, was recognised as early as the 1920s, when moquette draught-proofing strips were provided for District Line cabs. Later, attempts to improve the trainman's lot by providing cab heaters, which did little more than prevent the ice forming on the inside of the windows as well as the outside, were added to by increasing the power of the R Stock cab heater and by providing special heaters at the guard's position as well. Another try at improving matters came in 1959 with a scheme to prevent draughts by pressurising an R Stock cab. A roof-mounted fan was tried on 22681 but it never ran in service. Apparently, it couldn't be made to work.

CAB FRONTS

A roller blind destination indicator was fitted in the offside cab window. Presumably there was now sufficient faith in blind design to allow their re-introduction. They had been tried on the tube lines during the early 1920s but they didn't last well and were replaced by plates. As we've seen, the District always used plates. Blinds had, however, been in use on buses far many years so the R Stock blinds were supplied from the London Transport bus works at Chiswick. Their re-introduction was a success and they became standard until dot matrix signs appeared on the 1992 Tube Stock.

From very soon after the start of electric traction, trains were provided with brackets for set numbers. At first, the brackets were mounted on the outside of the cab near the top of the front ("M") door. When the 1927 K Stock was introduced, the brackets were moved to the middle of 'M' door immediately below the window. For the 1931 L Stock, they were moved inside the cab in the offside window over the destination plate box. They were much better protected in there as outside, they got wet, dirty, rusty and, at times, frozen. One might wonder today why no one ever thought of it before. On the R Stock, their status was upgraded again and a special box was provided for them. It was internally lit and provided with its own glazed panel in the cab front under the offside window. It also contained the weak field switch flag indicator.

Fig. 3: New 6-car R Stock train at Olympia in the early 1950s. This is one of the early deliveries. The driving car still has non-stop indicators either side of the second set of double doors and passenger door open buttons are in place. The cab front shows the destination blind over the offside cab window and the individually switched marker lights below the train set number. Just to the right of the train set number is the flag

The usual District style marker lights were continued on the R Stock but individually switched lamps were introduced in place of the shutters used on earlier cars. They were thus much brighter than they had been on earlier trains. Their use was discontinued from 1 January 1978 as their original purpose of identifying an approaching train for the signalman had been superseded by centralised control rooms. The R Stock tail light design was also new. Previously, one marker light was used as a red tail light but, on the R Stock, a pair of red lights was mounted separately on the headstock as had been done for the 1938 Tube Stock.

[2] In reality, the instructor could, if he wished, requisition a folding canvas seat from his Yardmaster. Not many bothered to since, if they got tired, they would take over from the trainee for a while so they could sit on the driving seat. In some cases, if they trusted the trainee, they would go home early and leave the trainee to finish the duty on his own.

Non-stop indicators were originally provided for the first cars of the first batch of R Stock but they didn't last long. They were removed from the few R38/1 cars which had them during their first overhaul and the later cars were not equipped with them. They were never fitted to any new R Stock cars, only to a few early Gloucester conversions. The decision not to use them had already been made in 1946, when it was decided to replace them with non-stop indicators on the platforms. I suspect the message didn't reach the shop floor soon enough to prevent their being fitted.

BOGIES

As we might expect, the new R Stock cars got new bogies but the converted cars retained the original design. W.S. Graff-Baker, the Chief Mechanical Engineer who oversaw the design for the bogies for both the original Q Stock trailers and the new R Stock NDMs, changed the design for the new stock because of problems with the complex form of the original design and because the all-welded construction didn't perform well on the poor track found on parts of the Underground. The new bogie appeared as in Fig. 4.

The 1938 bogies were almost identical to those provided for all the 1937-40-built cars of O, P and Q Stocks. However, those which were needed for the R38 cars all had to be of the "A" end configuration. This was because there were slight differences in layout between "A" and "D" end bogies that made the fitting of the LT 111 type traction motors provided for the R Stock easier on those bogies originally positioned at the "A" end of cars. In order to do this, a lot of Q38 trailers had to be lifted to have their "A" end bogies swapped for "D" end ones. They ended up having two "D" end bogies as a result, while their "A" end bogies went with other Q38 cars to Gloucester for conversion. As some preparatory work was done by LT before they were sent, a float of spare bogies was created by sending some of the cars to Gloucester on old "MR" type bogies which were left over when the ex-Metropolitan Railway car stock bodies from the Circle were scrapped.

The 1938 bogie was of all-welded construction with its steel coil bolster springs mounted outside the truck frames. The design was asymmetrical, i.e. the axles were disposed at 3ft 3in and 4ft 7in from the bogie centre – to give the maximum adhesion to the motored axle. A similar layout was adopted for the bogies built for the new R Stock cars but a number of modifications were incorporated. Prototype bogies for the R Stock were built by Gloucester and had been fitted to P Stock unit 13268-14239 in June 1944. Two different designs were used which, although not identical to the final

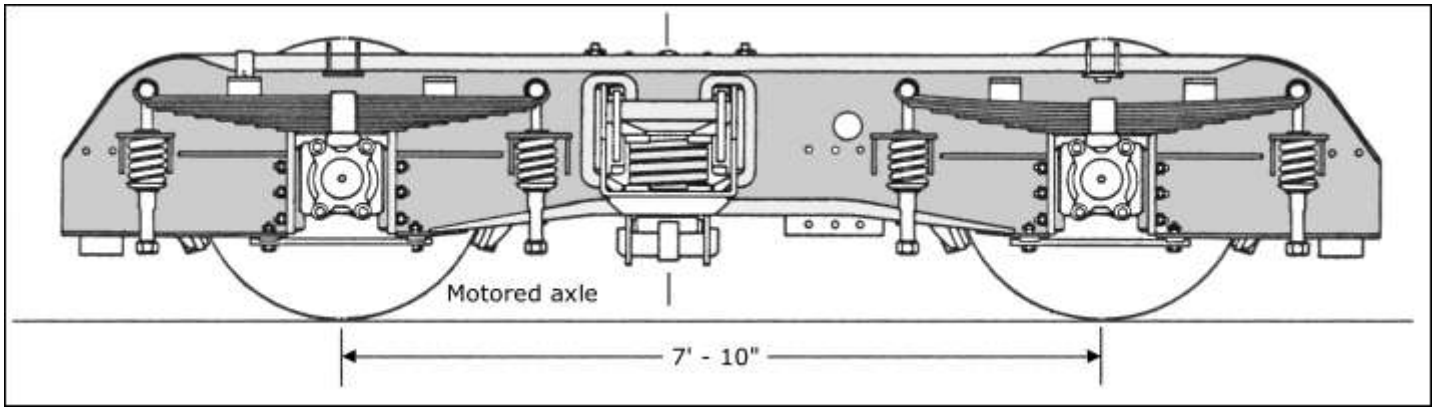

Fig. 4: R47 Stock bogie drawing, showing the asymmetrical arrangement where the bolster is closer to the motored end in order to allow more mass on the driving axle. The split was 3ft 3in and 4ft 7in. The top and bottom edges of the side plates are strengthened with channel sections welded on. The bogie headstocks were attached with welded brackets on the R47 design but these were riveted on the R49 version.

version used for the R Stock, provided much useful information. For example, the bolster suspension was redesigned after problems with the bolster hangers on the 1938 design. The idea of welding the transverse members to the side frames was retained on the R47 version but was abandoned in favour of riveting for the R49 design. The bogie frame was also provided with diagonal braces over the trailing axle to increase the stiffness. These were later removed.

Because of the two different types of cars – pre-war and post-war – and the consequent two different types of trucks, there were also two different brake cylinder arrangements. The 1938 bogies used a system of local brake rigging for each axle. There were therefore two brake cylinders, mounted on

top of the bogie frame and connected to the two blocks on each wheel by the rigging. On the new bogies, individual cylinders were provided for each brake block. Three cars, 21146, 22679 and 22680, all new R49 driving motors, were delivered with special test brake cylinders made of a lightweight alloy and designed so that one of the cylinders operated two brake blocks on adjacent wheels. These cars, and 23446, 23581 and 23582 were also fitted with lightweight door engines, e.p. brake units and auto-coupler disconnecting units.

Amongst other problems during the early days of R Stock deliveries, there was an acute shortage of motor wheels. To overcome this, a juggling exercise was carried out where a number of 235xx cars awaiting partners were lifted after delivery at Ealing Common and had their motor axles removed and replaced by old trailer wheels. The motor axles were fitted to cars being commissioned and then equipped with traction motors.

One innovation on the R Stock was a new form of shoegear. It was mounted on the truck frame and it was provided with lifting gear so that shoes could be raised clear of the current rails. Its most distinctive feature was the complete absence of a shoebeam, which was usually mounted between the axle boxes. Its development, use and eventual replacement presents us with an interesting story which shows how even the most careful testing and appraisal of equipment does not always lead to success when “let loose” in every day service on a large scale.

In general, current collector shoes were always a source of trouble. They still are. They’re vulnerable to trackside obstructions, subject to constant vibration and contact wear, they often suffered from broken cable connections due to work hardening and they were difficult to disconnect from the current rails if a car had to be isolated. In the early days of electric operation, 3ft long wooden “shoe paddles” were used to slip under the shoes of electrically defective cars. The shoe fuses were then unbolted by the driver (without turning off the current) to disconnect the current supply from the car. In later years, canvas shoe straps were provided and shoes could be permanently “strapped up” if necessary, although paddles have been kept as standard equipment ever since.

The paddling and strapping of shoes was a time consuming business. In an attempt to find a system that could speed up shoe isolation, a series of trials with shoe lifting gear took place during the last years of the Second World War. At the same time the opportunity was taken to try to eliminate the shoebeam itself. Shoebeams had become increasingly expensive and difficult to maintain during the war and replacement foreign hardwood became scarce. Some less satisfactory domestic timber substitutes were used and there were many cases of beams splitting at this time.

The first trial consisted of a frame mounted positive shoe fitted to the trailing end of a Q23 motor car in August 1946. It was equipped with a lever which rested on a stop on the adjacent axlebox cover. This acted as a register so that movement of the bogie frame relative to the track did not cause the shoe to lose contact with the current rails. The next trial began in November 1946 and involved the provision of a similar system but with the addition of lifting gear. This was fitted to the leading truck of P Stock car 13244 and consisted of a handwheel-operated cam acting on a horizontal bar. When the handwheel was turned, the cam lifted the bar which in turn lifted the shoe which was attached to it with canvas straps. The negative shoe also lifted at the same time.

The experimental equipment was thought to be successful enough for it to be adopted for the R Stock. It definitely had benefits, as it allowed quick isolation of a car and it got rid of the shoebeam. The continuing shortage of timber had resulted in a steel one being tried for a time just after the war on the South Acton shuttle car No.4167, but this did not get adopted. The new design of shoegear without beams certainly seemed to be the answer. Another purpose of the shoebeam was to carry the tripcock, that most important piece of safety equipment which would stop the train that attempted to pass a signal at danger. This also had to be frame mounted like the shoegear and again, a trial was carried out on 13244. Like the shoegear, it seemed to work and was adopted for the R Stock.

The road to hell, they say, is paved with good intentions but as soon as the R Stock began entering service in large numbers, it became apparent that all was not well with its new shoegear. A number of cars lost shoes on the line east of Bow Road, where old-type narrow current rail splays were provided, so a modification was introduced where all cars were fitted with slightly wider shoes to compensate. This suggests to me that there was something not quite right with the way the shoes hung off the beam when loose. Perhaps it was the angle of dangle.

There were also cases of leads coming adrift and welding themselves to the metal frame of the bogie – not a good idea and it tends to cause serious earthing problems. Some modifications to the shoegear were carried out during the mid-1950s in an attempt to overcome these and other mechanical issues but they do not seem to have solved the problems and, in the end, a return to shoebeams gradually became inevitable. No.23500 appeared in service in October 1957 with shoebeams and all the R59 trains had them from new. In August 1961, after six driving motor cars had been running with shoebeams instead of their original equipment, it was decided to convert the whole stock.

With the new shoebeam system, the positive shoes could no longer be lifted and had to be strapped up by hand. However, the negative shoes were designed to be lifted by means of a lever-operated cross-shaft accessed through a suitable trap door in the car floor. The lever, which was kept in the cab when not in use, had to be fitted into a socket at the end of the shaft and then used to rotate the shaft and lift the shoe in much the same way as the old handwheel system. In fact, much of the original material was used. Once the shoe was lifted, the shaft was held in place by a pin and the lifting lever could be removed. The use of lifting negative shoe gear was extended to all the new tube and surface stocks built in the late 1950s and early 1960s, using levers on tube cars and ropes on surface stock cars[3]. With the introduction of the 1967 Tube Stock, rope-operated, self-latching positive and negative lifting shoegear had become standard. So, although the initial excursion into this field on the R Stock was unsuccessful, it paved the way for future standardisation of shoe lifting gear and ended with the development of remotely operated power driven lifting gear.

Initially, the R Stock (Stages I and II) entered service with the system of a non-metallic brake insert (by Ferodo) contained in a cast iron shell with a guiding, grooved flange that surrounded the wheel flange. This prevented the block from slipping sideways off the tyre during braking[4]. However, it did wear out quickly and it eventually wore down the wheel flange as well. The next development was a non-metallic block without the flanged shell. The solution was to provide side-guiding pads for the brake block assembly on the inside of the truck frame. A number of trains were fitted with this idea, including an 8-car R Stock, 21111-23222-23221-23409+23543-22601+23534-22640, which was done in January 1956. Later that year, work began on fitting the rest of the stock with brake blocks, in place of inserts and shells and, since then, it has remained standard LU practice.

To be continued ……

[3] I recall having to do this shoe lifting exercise one afternoon in Uxbridge platform 1 on a defective 1959 Tube Stock motor car. The car examiner suggested that, as we had lifted the negative shoes using the lifting lever through a trap door in the car floor, the electrics were effectively isolated and there was no need to get unspeakably dirty crawling under the car to strap up the positive shoes. Since one side of the car was adjacent to the platform edge and I was considerably slimmer than the car examiner, it would have fallen to me to "do the dirty work". I was therefore happy to agree with him. The Controller was happy too as we didn't ask for the traction current to be switched off.

[4] I deal with the development of brake blocks during this period in Article 21 of this series, *Underground News* No.587, November 2010.